iodine. But in arranging the elements in vertical series we have often great difficulty in determining which are true homologues: we have no difficulty in grouping the alkali metals, the halogens, or sulphur, selenium and tellurium, but how are we to place copper, silver and gold, for example? Are we justified in regarding them as true homologues, and in inserting them as intermediate terms in the group of the alkali metals? Ought we not rather to look upon them as but pseudo-homologues, and ought we not to place them apart from the alkali metals, and apart even from each other in vertical succession? This would lead us, instead of classifying the elements in linear vertical series, to arrange them in pyramidal groups, of which the elements of lowest weight form the summits. In fact, there is no justification whatever for the conclusion that the elements belong to only eight families; the most illiberal treatment leads us to recognize at least twelve, and there is no reason to accept this as the limit. We can thus foresee the possible existence of a far larger number of elements than is at present known, differing probably from each other to a marked extent both in atomic weight and properties. But even then the limit is not reached. Those who have classified the elements according to the periodic system, after all—consciously or unconsciously—have but followed the practice adopted in classifying carbon compounds; and if we consider the results arrived at by the study of hydrocarbons, and apply the conclusions to the elements, there appears to be no difficulty in finding place for a far larger number of meta-elements than even Krüss and Nilson would require to accommodate their host of new claimants for elemental rank. If we arrange homologous hydrocarbons side by side in the order of molecular weight, a scheme corresponding to that devised for the elements will result; but, if molecular weight only be considered, the existence of isomeric hydrocarbons escapes notice: if, however, isomers are included, each simple vertical group at once assumes a pyramidal form. In like manner, if the possible existence of isomeric elements be granted, the periodic scheme would admit without difficulty of the existence of a still larger number of elements even than was above indicated.

Nickel and cobalt have often been supposed to be isomeric elements. According to the most recent determinations of their atomic weights, however, cobalt has a higher weight (58·74) than nickel (58·56); but this result is discredited by the fact that cobalt is usually placed before nickel in the periodic scheme, and should therefore have the lower weight, unless the two elements are isomeric.

Whether among the meta-elements of the rare earths there are not numerous cases of isomerism, remains for the future to determine. Unless, however, some new mode of discriminating other than that involved in determining the atomic weight be introduced, the problem is one which appears beyond our present powers, as experimental error cannot be entirely eliminated. But it is perhaps of all the problems in chemistry the most important to solve, on account of its bearing on the higher problem whether the elements are simple or compound substances. So many converging lines of evidence now render it probable that the elements are compounds that the discovery of isomeric elements would probably suffice to carry conviction to the minds of all who are open to argument on this question. H. E. A.

THE DURATION OF LIFE.[1]

JOHANNES MÜLLER, the celebrated German zoologist, said: "All organic beings are transitory; life passes from individual to individual with the appearance of immortality, but the individuals themselves perish." This proposition is perhaps not so true as it seems to be. Nevertheless, it is certainly true that life has its natural limits, at least in all those animals and plants that ordinarily come under the notice of the layman. But the duration of life is very different in different animals, and it would be interesting to know the reason of this. Differences in length of life have been thought to depend on differences in structure and composition. Obviously the size of an animal will fix a certain minimum of time required for growth: owing to the relation between increase of bulk and increase of absorbent surface, pointed out by Leuckhart and Spencer, a larger animal will require a longer time to secure the surplus of nutriment required for reproduction. The degree of structural complication will also fix a minimum time: the activity of the vital processes, the rate of metabolism,—*because it influences the time at which reproductive power, the goal of individual life, is reached*—will influence the total duration of life. But these inner conditions do not fix the duration of life. Birds, whose vital processes are so rapid, may far surpass in age the sluggish Amphibia. Among ants, the males, females, and workers are practically identical in size, complication of structure, or rate of metabolism; yet the females and workers live several years, the males only a few weeks.

We must seek in the environment for the forces finally determining the duration of life. We find the length of life to be in each case an adaptation arranged by natural selection in the interests of the species. So soon as an individual has produced young enough to fill up the gaps caused by death, it ceases to be of use for the species. Where fostering of the brood obtains—be it uterine or post-uterine—we expect and find a longer duration.

The apparently accidental causes of death remove far more individuals than natural death. The longer an individual lives the more chances of accident does it undergo; *and so selection, acting in the interests of the species, rather than prolonging the life, hurries on the time of reproduction*. At first, it seems impossible that the great age reached by many birds (Raptores may survive their century) is the shortest possible. But the enemies of the eggs and of the young of birds are very numerous. The death-rate is enormously greater than in the case of mammalian embryos developing within the parent. Adaptation to rapid flight precludes great fertility. Bad fliers like the *Phasianidæ* lay many more eggs in a season and live through far fewer seasons.

The adaptation is very clear in the case of the larval life of insects. The larvæ of bees and of many ichneumons placed in the midst of an abundant food supply become pupæ in a few days. The larval stage of predacious larvæ which have to waste time and energy in securing their prey, and of vegetable-feeding larvæ, on account of the less nutritious nature of their food, lasts very much longer. The usually short life of the imago bears no relation to the length or shortness of the larval life, but is directly adapted to its own purposes. In the simplest case, where copulation takes place as soon as the wings are dried, and where the eggs are deposited rapidly and carelessly, the whole adult life lasts but a few hours. Where the mate has to be sought, or the eggs deposited in special conditions, or where active habits preclude simultaneous maturation of eggs, the duration of life is prolonged in correspondence with the special requirements. Adult insects are perhaps the most hunted of animals, and in them is found the extreme case of adaptive shortening.

The inner changes on which natural death depends are not very clear. They can hardly depend on cell destruction; for it is upon that that the processes of life are based. More probably they depend on a failure to produce new generations of cells to replace the cells broken down in the vital processes.

The occurrence of death at all is a provision to secure

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[1] "Ueber die Dauer des Lebens." Von Dr. August Weismann. (Jena, 1882.)

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the greatest possible number of contemporary individuals of full strength. Contact with the world wastes away individuals with here an accident to-day, there an accident to-morrow. The possession of immortality by the individual, while a doubtful boon to it, would be a harmful luxury to the speies. Death makes room for new, complete individuals. Death is, however, by no means a universal attribute of organisms. In unicellular organisms the single cell is at once somatic and reproductive, and, while liable to accidental destruction, is potentially immortal. The Protozoon divides without a remainder; and the life of each Protozoon alive to-day has descended in direct continuity from the life of the primordial Protozoon.

In the Metazoa a division of labour has separated reproductive cells from somatic, and their complexity, by admitting of mutilations short of destruction, has rendered them mortal. The reproductive cells had to remain capable of an indefinite number of generations lest extinction of the race occurred; but when the somatic cells became specialized, there at once arose the possibility and the necessity of a limit to the number of generations.

It is clear that the size of an individual is an inherited property. Conditions of nutrition can only negatively determine growth. No superfluity of nutrition could build up the framework of a dwarf into a giant. Natural selection acting on variations has fixed the average size of individuals. It has in fact fixed the space limits of cell reproduction, and could have equally well fixed the limits in time—the duration of life—of individuals. There is a continuity of life from organism to organism through the divisions of the immortal germ-cells. The somatic cells arising from the germ-cell in each generation possess a limited reproductive capacity, and the limits are fixed by natural selection for each species so as to maintain the greatest possible number of contemporary individuals of full vigour.

P. CHALMERS MITCHELL.

NOTES.

THE French Association for the Advancement of Science has had a successful meeting at Oran, in Algeria. M. Laussedat, the President, chose as the subject of his address the civilizing influence of the sciences. This was the second meeting of the Association in Algeria, the first having been held in 1881.

THE nineteenth annual Conference of the National Union of Elementary Teachers was opened at Cheltenham on Monday. The President, Mr. Pope, in his inaugural address, spoke bitterly of the existing system of elementary education, which he denounced as a "failure." On Tuesday, the same tone was adopted by the Rev. E. M. M'Carthy, of King Edward's School, Birmingham, who read a paper to show that the system violates two of the fundamental principles of true education. Those principles are: (1) that the course of studies laid down for each stage should be in harmony with, and adapted to, the natural development of the individual child's mind and body; and (2) that all educational processes should develop faculties so as to produce habits of ready and accurate thinking, besides furnishing the mind with knowledge for use and imparting mechanical skill in the use of it.

PROF. KIEPERT, of Berlin, will start immediately on a journey of research in Western Asia Minor. He will be accompanied by Dr. E. Fabricius, the archæologist. The journey will last three months.

ON Easter Monday, 12,374 persons visited the Natural History Museum, South Kensington. The number of visitors on the corresponding day last year was 6570.

THE Report of the Meteorological Council for the year ending March 31, 1887, which has recently been issued, shows that at that date observations were being taken for the Office on 143 ships, exclusive of the vessels of the Royal Navy, all of which are supplied by the Council with instruments, although the keeping of a special meteorological log is optional. The work in hand by the marine branch is: (1) the completion of the synchronous charts of the North Atlantic; (2) a discussion of the meteorology of the Red Sea; (3) current charts for the Atlantic, Pacific, and Indian Oceans; (4) charts of the Aden cyclone of June 1885. In order to discover the cause of this storm and of its unusual course across the Arabian Sea, synchronous charts of the North Indian Ocean for the month of June are being prepared. In the weather branch, forecasts are drawn three times a day. A comparison of the results of the 8 p.m. forecasts gives 81 as the total percentage of success. Hay harvest forecasts were issued to some selected stations, as in previous years. Storm-warning telegrams are issued to 141 stations; the trans-Atlantic messages appear to have been of no practical value for the purpose of these warnings—rather the contrary, as they have occasionally caused the premature issue of warnings to our coasts when no storms followed. The principal changes in the climatological branch have been the erection of self-recording anemometers at Fleetwood and North Shields, and of an electric anemometer at Valentia Island, but unforeseen difficulties have hitherto prevented this from being brought into operation. The Report contains a table showing the distribution of gales round the coasts of the British Islands during each month for the fifteen years 1871–85.

M. L. CRULS, the Director of the Imperial Observatory at Rio de Janeiro, has made an appeal to all meteorological observers for assistance in the compilation of a "Universal Climatological Dictionary," which is intended to comprise, in a methodical form, the principal meteorological elements from as many stations as possible over the whole globe. The data asked for are the mean monthly and yearly temperatures, together with the monthly maxima and minima, and the dates of the yearly absolute extremes; the relative humidity, amount of cloud, rainfall, number of days of rain, thunderstorms, and frost, and the prevalent wind, in each month; the mean annual height of the barometer, and its mean annual oscillation. The work proposed by M. Cruls would be very useful, as, although information already exists for a great number of stations, it is dispersed in many different publications, and is expressed in different measures, so that comparisons are difficult. Details relating to the meteorological elements of his own country especially are much wanted.

IN the *Annales du Bureau central météorologique* of Paris for 1885, vol. i., M. Renou has discussed the rainfall of Paris for the last 200 years. The observations were begun in 1688 by Lahire. At that time the Observatory was outside Paris, some distance to the south, but it is now in the midst of a district surrounded by high buildings. It is a curious fact that soon after Leverrier assumed the directorship he planted some trees near the rain-gauge, which in time affected its readings; these trees were afterwards cut down by Admiral Mouchez. The rainfall seems to have undergone some changes in this long period. At the time of Lahire there was a marked maximum in July; now there are two less marked maxima in June and September. The number of rainy days amounts on an average to 169. Snow occurs very irregularly, but it is never entirely absent in any winter. The heaviest rainfall in a short period was on the 9th of September, 1865, which yielded over 2 inches on the terrace of the Observatory in $2\frac{1}{4}$ hours; the gauge on the ground overflowed.

WHILE studying the laws of dissolution of salts, M. Umoff came to the following correlation, which seems not to have been yet remarked, and which he communicated in a paper in the Memoirs of the Odessa Society of Naturalists (vol. xii. 1). For

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